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EXAMINER

KIM, PAUL

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

DETAILED ACTION

1. This Office action is responsive to the following communication: Amendment filed on 5 May 2008.
2. Claims 1-17 and 19-20 are pending and present for examination.

Response to Amendment

3. Claims 1 and 10 have been amended.
4. Claims 18 and 21-60 have been cancelled.
5. No claims have been newly added.

Double Patenting

6. As per the nonstatutory double patenting rejection, Applicant's terminal disclaimer is acknowledged. Accordingly, the rejection has been withdrawn.

Terminal Disclaimer

7. The terminal disclaimers filed on 3 January 2007 and 18 January 2007 disclaiming the terminal portion of any patent granted on this application have been reviewed and is accepted. The terminal disclaimers have been recorded.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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9. **Claims 1-12 and 19-20** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yanai et al (U.S. Patent No. 5,742,792, hereinafter referred to as Yanai), filed on 28 May 1996, and issued on 21 April 1998, in view of Armangau et al (USPGPUB No. 2004/0267836, hereinafter referred to as ARMANGAU), filed on 25 June 2003, and published on 30 December 2004.

10. **As per independent claims 1 and 10**, Yanai, in combination with Armangau, discloses:

A method for managing a data storage system that includes primary and secondary storage subsystems, including respective first and second non-volatile storage media, the method comprising:

maintaining a record on the secondary storage subsystem, which is predictive of locations to which data are to be written on the primary storage subsystem by a host processor {See Yanai, C11:L15-30, wherein this reads over "the present system maintains a list or index, utilizing one or more flag bits, in a hierarchical structure, on each physical and logical data storage device" and "each data storage system maintains an indication of write or copy pending 102 of both the primary data (M1) 104, and the secondary data (M2)"; and C12:L6-7, wherein this reads over "each data storage device keeps data validity information about its mirrored device"}, the record including a designation of locations to which the host is expected to write in the near future;

receiving at the primary storage subsystem, from the host processor, the data to be written to a specified location on the first non-volatile storage media {See Yanai, C11:L31-34, wherein this reads over "when a host computer writes data to a primary data storage system, it sets both the primary and secondary bits 104, 106 of the write pending bits 102 when data is written to cache"};

making a determination that the specified location is not included in the record, and responsively to the determination sending a message from the primary storage subsystem to the secondary storage subsystem so as to cause the secondary storage subsystem to update the record {See Yanai, C12:L6-21, wherein this reads over "every new write command goes to the accessible mirrored device along with information that the not accessible device has a track which is not valid" and "when a specific track is not shown on both the primary and secondary storage system, an indication of such will be assigned"};

wherein sending the message causes the secondary storage subsystem to predict one or more further locations to which the host processor has not yet written the data and is expected to write the data in a subsequent write operation, and to set a number of predicted locations in the record corresponding to the one or more further locations {See ARMANGAU, Para. [0099], wherein this reads over "[i]f the corresponding bit in the old bit map indicates a modified block in the primary file system volume not yet copied to the save volume, that it is copied on a prior basis to the save volume"; and Para. [0243], wherein this reads over "a meta bit map having a bit for indicating whether or not each allocated block of storage in the production file system is valid or not" and "a corresponding meta bit map is allocated or extended, and the bits in the meta bit map corresponding to the newly allocated storage are initially reset"};

signaling the host processor that the data have been stored in the data storage system responsively to receiving the data and, when the specified location was not included in the record, responsively to receiving an acknowledgment at the

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primary storage subsystem from the secondary storage subsystem indicating that the record has been updated *{See Yanai, C15:L36-43, wherein this reads over "[t]he data storage system containing the primary (R1) volume informs the host that an I/O sequence has successfully completed only after the data storage system containing the secondary (R2) volume acknowledges that it has received and checked the data"}; and*

storing the data in the specified location on both the first and second non-volatile storage media *{See Yanai, C11:L37-43, wherein this reads over "[w]hen the primary data storage system controller's disk adapter writes the data to the primary data storage device" and "[o]nce the secondary data storage system has written the data"}.*

While Yanai may fail to expressly disclose the use of bits and bitmap records in managing a data storage system, it is noted that Armangau discloses an invention wherein bits and bitmaps are used in allocating space within a data storage. The allocated data storage space is then held so that a subsequent write operation may write data in said allocated data storage space. Thus, it would have been obvious to one of ordinary skill in the art to modify the invention as disclosed by Yanai with the invention as disclosed by Armangau.

One of ordinary skill in the art would have been motivated to make this modification so that free locations within a storage subsystem may be held for a subsequent write operation to said location.

11. **As per dependent claim 2,** Yanai, in combination with Armangau, discloses:

The method according to claim 1, wherein sending the message comprises copying the data synchronously from the primary storage subsystem to the secondary storage subsystem *{See Yanai, C15:L36-39, wherein this reads over "data on the primary (R1) and secondary (R2) volumes are always fully synchronized at the completion of an I/O sequence"}.*

12. **As per dependent claim 3,** Yanai, in combination with Armangau, discloses:

The method according to claim 2, wherein storing the data comprises, upon making the determination that the specified location is included in the record, copying the data from the primary storage subsystem to the secondary storage subsystem asynchronously, without updating the record with respect to the specified location *{See Yanai, C2:L58-65, wherein this reads over "asynchronously with the primary host computer requesting the writing of data to the primary data storage system"}.*

13. **As per dependent claim 4,** Yanai, in combination with Armangau, discloses:

The method according to claim 3, wherein copying the data comprises transmitting the data between mutually-remote sites over a communication link between the sites *{See Yanai, C5:L16-20, wherein this reads over "the remote mirroring facility is provided with a migration mode which is active during host processing of a primary (R1) volume and iteratively copies updates from the primary (R1) volume to a secondary (R2) volume"}.*

14. **As per dependent claim 5,** Yanai, in combination with Armangau, discloses:

The method according to claim 3, wherein maintaining the record comprises maintaining a copy of the record on the primary storage subsystem, and wherein signaling the host processor comprises, upon making the determination that the specified location is included in the record, indicating to the host processor that the data have been stored without waiting to receive the acknowledgment from the secondary storage subsystem *{See Yanai, C3:L43-48, wherein this reads over "[t]he data storage system containing the primary (r1) volume informs the host that an I/O sequence has successfully completed without waiting for the data storage system containing the secondary (R2) volume to acknowledge that it has received and checked the data"}*.

15. **As per dependent claim 6**, Yanai, in combination with Armangau, discloses:

The method according to claim 1, wherein copying the data comprises creating a mirror on the secondary storage subsystem of the data received by the primary storage subsystem *{See Yanai, C58-65, wherein this reads over "the remote data copying or mirroring is completely independent of and transparent to the host computer system"}*.

16. **As per dependent claim 7**, Yanai, in combination with Armangau, discloses:

The method according to claim 6, and comprising, upon occurrence of a failure in the primary storage subsystem, configuring the secondary storage subsystem to serve as the primary storage subsystem so as to receive further data from the host processor to be stored by the data storage system *{See Yanai, C17:L39-44, wherein this reads over "Under the abnormal condition of the data being entirely absent from the data storage system due to a disk drive failure, however, a request for data access to a primary (R1) volume can be satisfied by obtaining the requested data from the secondary volume (R2) in the remote data storage system"}*.

17. **As per dependent claim 8**, Yanai, in combination with Armangau, discloses:

The method according to claim 6, and comprising, upon recovery of the system from a failure of the primary storage subsystem, conveying, responsively to the record, a portion of the data from the secondary storage subsystem to the primary storage subsystem for storage on the primary storage subsystem *{See Yanai, C27-L56-59, wherein this reads over "[w]hen the defective disk device is replaced, the data storage system re-synchronizes the mirrored pair, automatically copying data to the new disk"}*.

18. **As per dependent claim 9**, Yanai, in combination with Armangau, discloses:

The method according to claim 1, wherein maintaining and updating the record comprise marking respective bits in a bitmap corresponding to the locations to which the data are to be written on the first and second non-volatile storage media *{See Yanai, C35:L22-61}*.

19. **As per dependent claim 11**, Yanai, in combination with Armangau, discloses:

The method according to claim 10, wherein sending the message comprises modifying both the record and the copy of the record responsively to the specified location *{See Yanai, C11:L31-43, wherein this reads over "When the primary data storage system controller's disk adapter writes the data to the primary data storage device, it will reset bit 104 of the write pending*

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indicator bits 102. Similarly, once the secondary data storage system has written the data to the secondary data storage device, the secondary data storage write pending indicator bit 106 will be reset").

20. **As per dependent claim 12**, Yanai, in combination with Armangau, discloses:

The method according to claim 11, wherein modifying both the record and the copy of the record comprises adding a plurality of locations, including the specified location, to both the record and the copy of the record *{See Yanai, C11:L31-35, wherein this reads over "when a host computer writes data to a primary data storage system, it sets both the primary and secondary bits 104, 106 of the write pending bits 102 when data is written to cache"}*.

21. **As per dependent claim 18**, Yanai, in combination with Armangau, discloses:

The method according to claim 1, wherein sending the message causes the secondary storage subsystem to designate one or more further locations to which the host processor is expected to write the data in a subsequent write operation, and to add the one or more further locations to the record *{See Yanai, C25:L16-61}*.

22. **As per dependent claim 19**, Yanai, in combination with Armangau, discloses:

The method according to claim 18, wherein the one or more further locations comprise a predetermined number of consecutive locations in proximity to the specified location *{See Yanai, C40:L3-5, wherein this reads over "The preferred format for the information in the link buffer 505 is a string of track and record identifications and indications of where the records are found in the cache 228"}*.

23. **As per dependent claim 20**, Yanai, in combination with Armangau, discloses:

The method according to claim 18, wherein maintaining the record comprises recording the locations to which the data are written using an object-based storage technique, and wherein the one or more further locations are chosen based on a logical connection between storage objects *{See Yanai, C3:L25-29, wherein this reads over "The operating mode for each logical volume can be specified to best suit the purposes of the desired remote mirroring, the particular application using the volume, and the particular use of the data stored on the volume"}*.

24. **Claims 13-14** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yanai, in view of Armangau, and in further view of Dunham (U.S. Patent No. 6,269,431), filed on 13 August 1998, and issued on 31 July 2001.

25. **As per dependent claim 13**, Yanai, as modified by Armangau and Dunham, discloses:

The method according to claim 10, wherein maintaining the copy of the record comprises selecting one or more locations, other than the specified location, to be removed from the record, and instructing the secondary storage subsystem to remove the one or more locations from the record, so as to limit a size of the record *{See DUNHAM, C17:L67-C18:L4, wherein this reads over "[u]pon completion of a file deletion command, the secondary data storage subsystem would return an acknowledgment to the host, and the host could update its catalog to reflect deletion of the files from the back-up version of the file system"}*.

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While Yanai may fail to expressly disclose the instructing of the second storage subsystem to remove locations from a record, the combination of inventions disclosed in Yanai and Dunham would disclose an invention which removed one or more locations from the record. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the above invention suggested by Yanai by combining it with the invention disclosed by Dunham.

One of ordinary skill in the art would have been motivated to do this modification so that the size of the record may be limited by archiving and purging unnecessary entries from the record. In addition, Yanai and Dunham are analogous art because they belong to the same field of endeavor, such as, back up and mirroring data between a plurality of storage devices, memory allocation, and database management systems.

26. **As per dependent claim 14**, Yanai, as modified by Armangau and Dunham, discloses:

The method according to claim 13, wherein storing the data comprises copying the data to be stored in the one or more locations from the primary storage subsystem to the secondary storage subsystem *{See Yanai, C1:L30-38, wherein this reads over "the copying of the primary data to a secondary data storage system controller which forms part of a secondary data storage system"}, and*

wherein selecting the one or more locations comprises receiving a return message from the secondary storage subsystem indicating that the secondary storage subsystem has received the copied data *{See Yanai, C15:L36-43, wherein this reads over "[t]he data storage system containing the primary (R1) volume informs the host that an I/O sequence has successfully completed only after the data storage system containing the secondary (R2) volume acknowledges that it has received and checked the data"}, and*

selecting the one or more locations to be removed from the record responsively to the return message *{See DUNHAM, C17:L38-C18-24, wherein this reads over "[t]he procedure, for example, deletes files of the file system that have expired or that a user or application program did not request to be backed up" and "the back-end data mover updates the secondary directory to refer to the new, compacted file system and thereby delete the original backup version of the file system"}.*

While Yanai may fail to expressly disclose the selection of locations to be removed from the record responsively to the return message, the combination of inventions disclosed in Yanai and Dunham would disclose an invention which selected one or more locations from the record for removal. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was

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made to modify the above invention suggested by Yanai by combining it with the invention disclosed by Dunham.

One of ordinary skill in the art would have been motivated to do this modification so that the size of the record may be limited by archiving and purging selected entries from the record. In addition, Yanai and Dunham are analogous art because they belong to the same field of endeavor, such as, back up and mirroring data between a plurality of storage devices, memory allocation, and database management systems.

27. **Claims 15-17** are rejected under 35 U.S.C. 103(a) as being unpatentable over Yanai, in view of Armangau, in view of Dunham, and in further view of Official Notice.

28. **As per dependent claim 15**, the Examiner takes Official Notice that it would have been obvious to one of ordinary skill in the art at the time the invention was made to identify locations containing identical data since multiple copies of identical data need not be stored in multiple locations. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to remove the location which was least-recently added so that the least-current location containing the identical data may be discarded.

29. **As per dependent claim 16**, the Examiner takes Official Notice that it would have been obvious to one of ordinary skill in the art at the time the invention was made to group the entries added to the copy of the record and the record in generations so that the generations, or versions, of entries may be used in discarding entries of a certain generation or version using a batch method.

30. **As per dependent claim 17**, the Examiner takes Official Notice that it would have been obvious to one of ordinary skill in the art at the time the invention was made to append an instruction to the message sent from the primary storage subsystem to the secondary storage subsystem, so that the appended instruction may be used in providing the secondary storage subsystem with the instructions to remove the locations.

Response to Arguments

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31. Applicant's arguments filed 5 May 2008 have been fully considered but they are not persuasive.

a. Claim Rejections under 35 U.S.C. 103 in view of Yanai and Armangau

Applicant asserts the argument that "there is nothing in Yanai's record that is even remotely predictive of locations to which a host is expect to write in the near future." See Amendment, page 10. The Examiner respectfully disagrees. It is noted that Yanai discloses a system wherein each data storage system maintains an indication of write or copy pending 102 of both the primary data (M1) 104, and the secondary data (M2) 106." See Yanai, C11:L19-30. Furthermore, Yanai discloses that "when a host computer write data to a primary data storage system, it sets both the primary and secondary bits 104, 106 of the write pending bits 102 when data is written to cache." See Yanai, C11:L32-43. Accordingly, it is noted that Yanai discloses an invention wherein the host computer (i.e. the host) is able to set bits indicating a write or copy function to either a primary or secondary data storage (i.e. the location).

Thus, Yanai, in combination with Armangau, disclose the limitations of claims 1 and 10. Accordingly, the rejections of claims 1 and 10 under 35 U.S.C. 103 in view of Yanai and Armangau are sustained.

b. Claim Rejections under 35 U.S.C. 103 in view of Official Notice

In the prior Office action, the Examiner took Official Notice that "it would have been obvious to one of ordinary skill in the art at the time the invention was made to identify locations containing identical data since multiple copies of identical data need not be stored in multiple locations." See Non-Final Office action, dated 15 February 2008. In response, Applicant asserts the argument that the Examiner's reasoning "runs diametrically against the whole purpose of redundant storage, in which the same data are systematically stored in both the primary and secondary subsystems, as is recited explicitly in the independent claims." See Amendment, page 13. The Examiner respectfully disagrees. It is noted that the present limitations of claim 15 recite a method wherein one or more locations, which contain substantially identical data, are identified for removal of one of the identified locations that was least-recently added to the

record. Furthermore, the Examiner notes that the method step is directed to the removal of a location containing substantial identical data (claim 15) with the purpose of limiting the size of the record (claim 13). While Applicant has asserted that the removal of locations "runs diametrically against the whole purpose of redundant storage," the Applicant is directed to the recited features of the present invention which specifically disclose methods for removing data which substantially identical for the purpose of limiting the record size. In response to Applicant's request for documentary evidence, the Examiner has provided the prior art of Qiu et al (U.S. Patent No. 6,377,960). Qiu et al discloses a method wherein "the prior versions of the datastore may be deleted to conserve storage within the file system." See Qiu et al, C10:L33-48. Wherein a system stores multiple versions of a file (i.e. substantially identical data), Qiu et al discloses a computing system which deletes old versions of files. Accordingly, it is noted that it would have been obvious to one of ordinary skill in the art to have a method step wherein locations with substantially identical data are found in a record, the oldest location would be selected for removal from the record.

Secondly, in regards to claim 16, Applicant asserts the argument that "the Examiner has given no rationale as to why entries of locations in a predictive record might be considered 'versions,' or why the same 'versions' should be grouped and then removed from both primary secondary subsystem." See Amendment, page 14. The Examiner notes that for purposes of clarification that the grouping of entries added to the record have been construed as versions. That is, wherein the claim recites a generation of entries, it is noted that said generation of entries may read upon as versions of entries being made to the record. Furthermore, in response to Applicant's request for documentary evidence, the Examiner has provided the prior art of Menon et al (U.S. Patent No. 6,397,229). Menon et al discloses a method wherein bits of a bit map are set and cleared according to the backup status of the associated sector. See Menon et al, C4:L40-C5:L6. Specifically, Menon et al discloses a system wherein a write operation to a sector results in the setting of a bit in the bit map. Thereafter, once the sector has been backed

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up to a tape drive, the bit indication associated with the sector is cleared. Accordingly, it would have been obvious to one of ordinary skill in the art the process of writing to a sector would result in the setting of a bit map (i.e. adding one or more entries to the record). Furthermore, said bits could be grouped and removed from the records when the sectors are backed up to the tape drive.

Lastly, in regards to claim 17, Applicant asserts the argument that "the use of the same message to cause the secondary storage subsystem to predictively add locations and to remove locations from the record is not in any way obvious." See Amendment, page 14. The Examiner respectfully disagrees in that Menon et al discloses a method wherein a backup/write request for a sector is sent and processed, the bit associated with the sector is changed. Thereafter, once the sector is backed up onto a tape drive, the associated bit is cleared. Accordingly, one of ordinary skill in the art would have been able to discern that the backup/write request (i.e. the same message) would cause the secondary storage subsystem to predictively add and clear bits from the record.

Accordingly, for the aforementioned reasons above, the rejections of claims 15-17 in view of Official Notice are sustained.

Conclusion

32. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing

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date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

33. Any inquiry concerning this communication or earlier communications from the examiner should be directed to PAUL KIM whose telephone number is (571)272-2737. The examiner can normally be reached on M-F, 9am - 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tony Mahmoudi can be reached on (571) 272-4078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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